

heart disease. However, the anomalies were found more often in the resting E.C.G. than after exercise. The second part of the study is more interesting. The authors re-examined some of the men in the two groups, a procedure inevitably more satisfactory than a postal follow-up. Only a little more than half the men with anomalous cardiograms could be examined (namely, 73), and this may have produced bias, though no obvious source of it was noted. For comparison 104 men were available whose E.C.G.s were normal at the original survey. There was a significant difference in the incidence of angina pectoris between the group with the anomalous E.C.G.s and the controls. Eleven subjects in the first group and only three in the controls were found to have developed clinical evidence of coronary artery disease. These authors have thus shown that there is a practical method of finding a group of people with a higher than average risk of developing this disease some years later. While there is at present no known way of certainly preventing coronary artery disease, the identification of this group with potential disease will probably be of more value in studies first of the natural history and later of the modification of the condition produced by therapeutic trials or environmental changes. Atheroma may be reversible in experimental animals given an atherogenic diet. There is no proof that it is reversible in man, though such data as the decreased incidence of ischaemic heart disease in some European countries suffering starvation in the second world war are suggestive. The effect of treatment may be more easily and clearly manifest in a group with potential rather than actual coronary artery disease. However, the problem of cardiac infarction is not simply the problem of atheroma. Whereas coronary artery disease has increased rapidly in recent years, there has been little change in the incidence of strokes.

The authors are at pains to point out the limitations of their study on individual prognosis. At present, no patient should have treatment solely on the basis of a minor anomaly in the cardiogram, and it is better for him to remain in ignorance of his abnormality.

HEALTH PROBLEMS IN NUCLEAR SUBMARINES

The impact of nuclear submarines on medicine would seem at first to concern only the relatively few naval medical officers who serve in them. But the profession as a whole cannot fail to be interested in this subject ;

moreover, in the not too distant future civilian port medical officers will have to satisfy themselves about the safe reception and supervision of nuclear-powered ships—which Britain will soon be making—in commercial and possibly naval ports.

Nuclear submarines put three special responsibilities on medical officers: the maintenance of a habitable environment; the medical and psychological care of the crew and the selection of suitable men; and the establishment of a port health organization. Fortunately there is much knowledge and experience from American sources which has been made freely available in this country. In addition, much of value has been learnt from conventional submarines which can be applied to the new conditions. Environmental habitability implies much more than the supplying of oxygen and the removal of carbon dioxide, though even this is rendered more difficult with prolonged submersion. To contain a hundred or so men in a confined space below the sea with no facility for natural replacement of the air for months necessitates a careful consideration of every possible contamination which may arise. Success depends upon a study of all likely sources of contamination, toxicological experience, continuous monitoring of the atmosphere, and a careful surveillance of exposed personnel.

First the impurities which the men themselves produce must be removed. These will include not only exhaled carbon dioxide but moisture, bacteria, body odours, carbon monoxide, and nicotine-laden aerosols from smoking, fluff and dust from clothing and bedding, volatile ingredients from lighter fuel, hair oil, and after-shave lotion, and even the ionizing radiations from luminous watches. Some of these may seem trivial, but it should be remembered that in a fully closed environment any substance liberated, however slowly, will ultimately reach an unpleasantly conspicuous level unless steps are taken to prevent it. The domestic services are a second source of impurities, producing such things as volatile hydrocarbons from cooking, polishes, cleaning fluids, and possible leaks of freon from refrigerators. Finally, the submarine's machinery may give rise to oil fumes, battery gases, and, of course, radioactive contaminants.

Though the list of atmospheric contaminants is long and growing daily systematic and effective control is already possible. The major impurities are subject to continuous monitoring by such modern techniques as mass spectrography: for the remainder frequent sampling and examination is carried out by the submarine's medical and laboratory personnel. Purification is generally achieved by chemical absorption of carbon dioxide, destruction by heat of

¹ Davies, L. G., *Brit. Heart J.*, 1958, 20, 153.

² Todd, J. W., *Lancet*, 1959, 1, 845.

³ Fowler, P. B. S., *Brit. med. J.*, 1962, 2, 1638.

⁴ Manning, G. W., *Amer. Heart J.*, 1957, 54, 823.

⁵ Wood, F., McGregor, M., Magidson, O., and Whittaker, W., *Brit. Heart J.*, 1950, 12, 363.

volatile substances, and filtration or electrostatic precipitation of suspended matter. Control of temperature and humidity is essential, and oxygen is added from storage cylinders or chemical generators. Other impurities which cannot be removed by these methods must be controlled by elimination of the source, or, failing this, it may be necessary to bring the submarine to the surface for ventilation.

To the uninitiated radiation comes to mind first as the new and major hazard of these new vessels. In actual fact this is one of the least worries, for so efficient is the screening of the reactor that, provided, as is customary, all luminous instruments or watches are eliminated, the level of radiation is below that in surface ships and establishments. This is due to the protection the sea above gives from cosmic radiation. Nevertheless an efficient routine monitoring service for radiation must be maintained. The health of the crew is of the utmost concern and depends largely upon environmental control, clinical screening of the men before embarkation, careful selection, and the establishment of good morale. Experience in Britain and America, even in the latter's long-submerging nuclear submarines, has shown that the health of the submariner is every bit as good as that of his surface colleague.

Submarine service is largely voluntary, which ensures some degree of natural selection, and it is not surprisingly the case that the maturer individual is preferred. In spite of long periods of complete isolation the service has much to offer in comradeship and prestige (extra pay not excluded), and opportunities exist for additional reading, study, and handicrafts. There are ingenious methods to combat boredom and maintain physical fitness. Welfare and comfort are given much attention, and the food is good. Manning submarines should be no real problem, and indeed experience has shown that continued duty in this branch brings out the best qualities in the British sailor.

Finally, and of special interest to the general population, is the need to ensure that the entry into both commercial and naval ports and the docking of nuclear submarines can be completed in absolute safety. This will equally apply to the nuclear-powered surface ships of the future. Nuclear-propelled vessels must from time to time be refuelled and refitted, and the possibility of a collision in harbour approaches cannot be ignored. Thus plans have been made to deal with any possible mishap based on what is considered to be the "maximum credible accident." This must primarily be the responsibility of the port health authority, though at present the advice of Admiralty experts is available. Nuclear submarines take many

years to build, so that ample time is available for planning and training, both ashore and afloat. All naval medical officers have for many years received additional instruction in submarine physiology and nuclear medicine, and more recently a number of them have had intensive training as specialists in these subjects.

Courses in "atomic medicine" have been held during the past twelve years or so at the Royal Naval Medical School not only for naval doctors (active and reserve) but for those of other services and N.A.T.O. forces. In recent years these courses have also been attended by an increasing number of civilian doctors, medical officers of health, port medical officers, and representatives of regional hospital boards. In expectation of a growing demand these courses are being extended and a new block of radiobiological laboratories is now being built at the School, which is being developed as a centre for nuclear medicine.

PUBLIC HEALTH DILEMMAS

In his presidential address to the Society of Medical Officers of Health Dr. Edward Hughes,¹ medical officer of health of Reading, spoke of a dilemma which has faced many members of the public health service—whether to confine their work to the clinical sphere or to undertake what is called medical administration. At the recent conference² of public health medical officers in B.M.A. House several speakers remarked that the majority of public health medical officers did clinical work, and the conference approved a resolution that the grade of clinical medical officer (at present called medical officer in department or assistant medical officer) should be a career grade and be remunerated accordingly. From what followed in his presidential address it would seem that Dr. Hughes would not be totally against this, though retaining some doubts about it. In Reading assistant medical officers of health used to attend the paediatricians' ward rounds and the out-patient sessions of other departments. This practice has declined, though regular meetings with paediatricians to discuss individual children still continue. The municipal medical antenatal clinics have disappeared altogether. Assistant medical officers of health, who naturally look forward to promotion in their service, do not now see what advantage they are going to get from a close attachment to the hospital service. Dr. Hughes therefore asks: "Can the public health department make any worthwhile contribution to the clinical services?" If it can, then in his view any scheme which envisages a close connexion with